

Meteo 466—Homework 6 (extra credit)

(due Thurs., Mar. 30)

Nitrogen can escape from Mars by way of the reaction



This *dissociative recombination* reaction releases 3.46 eV of energy, after subtracting out the energy needed to lift $\text{N}(^2\text{D})$ to its excited electronic state. This energy goes into kinetic energy of the product N atoms. If both of the N atoms were ^{14}N , they should have the same velocities. But if one of them is ^{15}N , then the velocities should be different. ^{14}N should be moving faster than ^{15}N , and this leads to fractionation when the atoms escape.

The lecture slides (Lecture 14, slide 33) say that ^{14}N should have a velocity of 4.87 km/s, while ^{15}N should have a velocity of 4.70 km/s. I think I got these numbers from an old paper, but I may have calculated them myself. In any case, when I recalculate the velocities, I get 4.95 km/s for ^{14}N and 4.62 km/s for ^{15}N . Which answer is right?

Use the following data:

mass of an H atom:	1.67×10^{-27} kg
atomic weight of ^{14}N :	14.00
“ “ “ ^{15}N :	15.00
1 eV = 1.602×10^{-12} erg = 1.602×10^{-19} J	